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BICYCLES

Proposed Classification as Banned Hazardous Substance

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[21 CFR Parts 191, 191c]

BICYCLES

Proposed Classification as Banned Hazardous Substance

Section 2(f)(1)(D) of the Federal Hazardous Substances Act provides for the classification of any toy or other article intended for use by children as a hazardous substance upon a determination by regulation that it presents a mechanical hazard as defined by section 2(s) of the act. Under section 2(q)(1)(A) of the act, such classification also makes the toy or article a banned hazardous substance. Banned toys and other children's articles are listed in 21 CFR 191.9a.

Through investigations conducted by the Food and Drug Administration and the National Safety Council, and through data provided by the National Electronic Injury Surveillance System (NEISS), the Commissioner of Food and Drugs has determined that bicycles and/or certain components thereof are a contributing factor in the death and serious injury of children.

Estimates provided through the NEISS study indicate that more than 1 million accidents annually are related to bicycles. The National Safety Council reports that 38,000 bicycle accidents also involve an automotive vehicle, and that over 800 of these result in death to the bicyclist. These studies further indicate that the major causes of these accidents are user education, the environment in which the bicycle is used, and the bicycle itself.

A study of the product causation data identified the following areas of product deficiency: (1) The rider's foot slipping off of the pedal, (2) brake failure, (3) a component failure, and (4) poor night visibility. Secondary injury causes relating to protruding hardware, sharp edges, and sharp points are also shown to be a factor in the accident picture.

The following recommendations concerning the identified hazards are apparent after review of the NEISS data: (1) Reflectorization should be increased to make a bicycle not only visible in the dark, but also identifiable as a bicycle, (2) pedals should be slip resistant, (3) gear shifts and other devices on the horizontal bars of bicycles should be designed to reduce risk of injury, (4) the maximum safe seatpost length should be defined, (5) front wheel brakes should be eliminated when they exist as the sole means of braking, (6) hand levers for brakes should be designed for the intended operator, (7) any regulation concerning bicycle safety should include coverage of sidewalk bicycles, and (8) rough and sharp edges should be eliminated from hardware and various components.

The Commissioner concludes that proper assembly, maintenance, and user education are necessary in any effort to reduce needless bicycle accidents. Accordingly, this proposal deals with the problem areas of bicycle safety that have been identified by FDA. Only those areas where a clear safety implication has been identified are covered. The requirements specified set forth the basic criteria for a safe product. These criteria are intended to identify and deal with potential hazards which are beyond the ability of a child, or his parent, to evaluate. Such hazards can, without warning, result in a sudden and potentially dangerous failure. The Commissioner has determined that failures which provide adequate warning, such as a gradual physical or performance deterioration, should not be reasons for banning bicycles which otherwise comply with these specifications.

Therefore, the Commissioner proposes to amend part 191 to ban hazardous bicycles intended for use by children and to promulgate part 191c to establish safety requirements for certain children's bicycles.

Accordingly, pursuant to provisions of the Federal Hazardous Substances Act (secs. 2(f)(1)(D), (q)(1), (s), 3(e)(1), 74 Stat. 372, 374, 375, as amended, 80 Stat. 1304–1305, 83 Stat. 187–189; 15 U.S.C. 1261, 1262) and under authority delegated to him (21 CFR 2.120), the Commissioner proposes that § 191.9a(a) be amended by adding a new subparagraph (12) and that a new part 191c be added to title 21, chapter I, as follows:

§ 191.9a Banned toys and other banned articles intended for use by children.

(a) *Toys and other children's articles presenting mechanical hazards.*

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(12) Any bicycle intended for use by children under 16 years of age that does not comply with the requirements of part 191c of this chapter.

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PART 191c—REQUIREMENTS FOR BICYCLES

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AUTHORITY.—Secs. 2(f)(1)(D), (q)(1), (s), 3(e)(1), 74 Stat. 372, 374, 375, as amended 80 Stat. 1304–1305, 83 Stat. 187–189; 15 U.S.C. 1261, 1262.

§ 191c.1 Scope.

This part 191c covers all bicycles intended for use by children of less than 16 years of age, whether for recreational, utility, or any other purpose. Bicycles intended for nonroadway use by young children under close adult supervision and meeting the definition of sidewalk bicycle in § 191c.2(b) are subject to this part 191c with certain qualifications as specified in § 191c.9.

§ 191c.2 Definitions.

The following definitions apply to this part 191c:

(a) *Bicycle.*—The term "bicycle" means a two-wheeled vehicle having a rear drive wheel which is solely human-powered.

(b) *Sidewalk bicycle.*—The term "sidewalk bicycle" means a bicycle having a seat height of less than 24 inches when the seat is in the lowest adjustable position.

(c) *Seat height.*—The term "seat height" means the dimension from the ground plane to the point on the seat surface that is intersected by the seat post centerline (or the center of the seating area if no seat post exists), normal to the ground plane, when a bicycle is in the upright position.

(d) *Manufacturer.*—The term "manufacturer" means any person who manufacturers or distributes a bicycle.

(e) *Consumer.*—The term "consumer" means the final user of a bicycle.

(f) *Brittle (brittleness).*—The term "brittle (brittleness)" means the property of breaking without perceptible warning or without visible deformation.

(g) *Fracture failure.*—The term "fracture failure" means the separation of a component into two or more parts.

(h) *Normal.*—The term "normal" means perpendicular to, when specifying direction of load or dimension.

§ 191c.3 Bicycle assembly.

A bicycle subject to the provisions of this part 191c shall be selected for inspection and testing in the condition that the consumer would normally receive the bicycle. If the manufacturer presents any or all of his bicycles to the consumer in an unassembled or partially assembled condition, the unit will be selected for test and inspection in the shipping carton.

(a) *Fully assembled.*—A fully assembled bicycle shall have attached to its frame an owner's manual containing maintenance, operating, and safety instructions.

(b) *Partially assembled.*—An unassembled or partially assembled bicycle shall be inspected after it has been assembled according to the instructions. Required assembly shall not exceed normal skills possessed by an adult of normal intelligence with no technical training. The following items shall be included with the packaged unit:

(1) An owner's manual containing maintenance, operating, and safety instructions.

(2) Assembly tools in excess of standard 7-inch flat bladed screwdriver, standard slipjoint pliers, and air pump for tire inflation.

(c) *Instructions.*—The instructions shall include, but not be limited to, the following:

(1) *Maintenance.*—Instructions regarding proper maintenance of brakes, control cables, bearing adjustments, wheel adjustments, lubrication, gearing adjustments, reflectors, handlebar and seat adjustments, and tires.

(2) *Operation and safety.*—General operation of brakes and gears, wet weather caution concerning increased stopping distances, nighttime operating warnings, and guide for safe on-and-off road operation.

(3) *Assembly.*—Complete instructions and part identification necessary for accomplishing proper assembly and safe operation.

(d) *Handbrake assembly.*—When a handbrake is installed and adjusted in accordance with the manufacturer's instructions, less than 10 pounds of force, applied to the hand lever at a point 1 inch from the open end of the lever, shall cause the brakeshoes to engage the brake surface of the wheel. When the force is removed, the hand levers and the brakeshoes shall return to their original installed positions.

(e) *Sharp edges.*—There shall be no unfinished sheared metal edges or other sharp parts on a bicycle or its components or attachments that are, or may be, exposed to hands or legs.

(f) *Protrusions.*—There shall be no exposed protrusions greater than five-sixteenths inch long, after assembly, which terminate in less than a full ¼-inch radius. There shall be no protrusions between the bicycle seat and the handlebar stem that extend more than 3½ inches to the rear of the stem assembly. Screw threads shall be limited to a protrusion length of one major diameter of the screw beyond the internally threaded mating member. Screw threads that are exposed to any part of a rider's body when the rider is in any normal riding position shall be limited to a ⅛-inch protrusion beyond the internally threaded mating member.

(g) *Control cable assembly.*—The ends of all adjustment cables shall be capped or treated to prevent cable unraveling and skin puncture. Protective devices shall withstand a pull of 2 pounds without disengagement from the cable. The cable shall not fray over the edges or when entering or exiting the sheath. The cable controlling the rear brake shall be actuated by a hand lever mounted on the right handlebar. The cable controlling the front brake shall be mounted on the left handlebar.

(h) *Pedal clearance.*—The pedals shall allow 25° minimum lateral tilt of the bicycle from the vertical when the pedal crank is in its lowest position and the tread surface of the pedal is parallel to the ground plane. The pedals shall clear the front wheel and fender when the tread surface of the pedal is parallel to the ground plane and the pedal crank arm is rotated to its closest proximity to the front tire and the front wheel is turned to its closest proximity to the pedal. Toe clearance shall be at least 4½ inches measured from the rotation axis of the pedal at the center of the foot tread forward to the tire or fender surface.

(i) *Chain guard.*—A bicycle shall be equipped with a protective device(s) that shields the junction of the drive chain and drive sprocket against entrapment of clothing or body parts. The device must shield the chain for not less than 1 inch from the point of engagement with the drive sprocket. Where multiple drive sprockets are employed, the largest sprocket shall have teeth shielded at least by a disc that is 1 inch greater in diameter than the maximum diameter of the largest drive sprocket and that is not more than one-half inch from the sprocket and located between the sprocket and the pedal crank.

(j) *Tires.*—The manufacturer's recommended inflation pressure shall be molded into the sidewall of the tire in a legend not less than one-eighth inch in height. The tires shall be compatible to the rim design. After inflation to 110 percent of the maximum recommended inflation pressure as indicated on the tire sidewall, the tire shall remain intact on the rim and show no evidence of creeping with respect to the rim.

§ 191c.4 Components.

(a) *Wheels.*—(1) *Spokes.*—Spokes shall be tight. Any spoke that rattles when plucked with the finger shall be considered loose. There shall be no missing spokes.

(2) *Alinement.*—Alinement of the wheel assembly in a bicycle shall allow not less than 1/16-inch clearance between the tire and any frame member. The rotating wheel shall not contact any nonrotating members when the brakes are not actuated.

(3) *Rotational trueness.*—The wheel and tire assembly shall have sufficient radial and lateral alinement to allow compliance with paragraph (a)(2) of this section and paragraph (h)(6) of this section when the wheel is rotated to any position.

(4) *Braking surfaces.*—Braking surfaces exposed to rain or other wet road conditions shall be smooth, free of embossment or stippling, and protected from ferric oxidation.

(5) *Rims.*—Rims shall retain the spokes and tire when tested by the method described in paragraph (a)(6) of this section.

(6) *Rim test.*—The fully and properly assembled wheel and tire shall be supported circumferentially at the tire sidewall and a load of 450 pounds shall be applied to the axle, normal to the plane of the wheel, for not less than 30 seconds. The load need only be applied to the front wheel if the front and rear rims are of identical construction. If the rear wheel is loaded in this prescribed manner and the wheel hub is offset, the load shall be applied in the direction of the offset only. After this test the wheel and tire assembly shall be inspected for compliance with this paragraph (a) and the wheel shall turn freely and without roughness.

(7) *Wheel hubs.*—Wheel hubs shall be capable of being removed from a bicycle frame to facilitate tire changing and other normal maintenance operations. Any bearing adjustments shall be secure against not less than 10 in-lb of torque to the adjusting elements. Quick release hubs shall be provided with levers that indicate positively whether the levers are in a locked or unlocked position, with such indications clearly visible to the rider from the riding position. The quick-release clamping action shall emboss the frame or fork when locked. If threaded nuts are used to secure the wheel axle to the frame or fork, a locking provision shall be incorporated which requires not less than 180° of rotation of the nut from finger-tight to full-tight condition.

(i) *Front hubs.*—Front hubs that are secured to the fork with threaded nuts shall have a positive retention feature that will prevent a wheel from separating from the bicycle when the threaded nuts are opened 360° from a finger-tight condition and a separation force of 25 pounds is applied in line with the slot in the forkends. Fender (mudguard) struts, caliper brakes, or other accessories shall not be allowed to affect the measurement of compliance with this requirement.

(ii) *Rear hubs.*—Rear hubs shall be attached to the frame with either hardware that embosses the frame, when a wheel is installed, or other provision for positive retention of the hub with respect to the frame. Frictional clamping of flat washer surfaces are not considered adequate for positive retention.

(iii) *Derailleur—rear wheels.*—Rear wheels used with derailleur shall have a spoke protection disc of sufficient diameter to prevent the derailleur mechanism from engaging the spokes if the drive chain loosens or breaks. With the derailleur control cable loosened and drive chain removed, the disc shall not let the mechanism contact the spokes when the derailleur is depressed into the wheel. The rear wheel derailleur shall have incorporated a provision to prevent the drive chain or any other part of the chain shifting mechanism from interfering with the rotation of a wheel when the mechanism is improperly adjusted. It shall not be possible to so adjust the shifting mechanism that the drive chain or idler sprockets can engage the rotating components of the wheel.

(b) *Front fork.*—The front fork shall be capable of absorbing 350 in-lb of energy without fracture.

(c) *Fork test.*—With the fork stem supported in a 3-inch vee block and secured by the method described in figure 1, a test load shall be applied at the axle attachment in a direction perpendicular to the center line of the stem and against the direction of the rake. Load and deflection readings shall be recorded and plotted at the point of loading. At 2-inch reflection, the absorbed energy shall be at least 350 in-lb.

(d) *Frame.*—A bicycle frame shall be capable of supporting the fork without fracture when a load of 200 pounds is applied to the fork at the axle attachment point against the direction of the rake in line with the rear wheel axle.

(e) *Handlebar stem.*—The handlebar stem shall contain a permanent ring or mark which clearly indicates the minimum insertion depth of the handlebar stem into the fork stem. The insertion mark shall be not less than 2½ times the shaft diameter from the lowest point of the shaft, and there shall be at least one shaft diameter length of contiguous circumferential shaft material below the mark. The handlebar stem shall be capable of supporting without fracture a load of 450 lb when the stem is supported at its minimum insertion depth and loaded through the handlebar attachment point in a forward direction

and depressed 45° from the perpendicular to the center line of the head tube shank of the stem (fig. 2).

(f) *Pedals.*—The pedals for a bicycle shall be a pair having right-hand/left-hand symmetry. If the pedals are provided with ball bearings in both ends of the pedals, the attaching threads shall be right-hand on the right pedal and left-hand on the left pedal. If the pedals rotate about their own axis on sleeve bearings, the pedal shaft shall be integral with the crank or attached to the crank with a locknut or standard nut and lockwasher. The tread shall have slip resistance, in accordance with paragraph (g) of this section, and shall be an integral part of the pedal construction. The tread surface shall not be strips or pads applied with adhesive. The tread surface shall be present on both top and bottom surfaces of the pedal except where the pedal has a definite preferred position. Any such preferred position shall automatically present a tread surface to the rider's foot. Pedals intended to be used with removable toe clips shall be labeled with the statement "CAUTION—Use of this pedal without toe clips is dangerous." The caution label shall be securely attached to each pedal. Pedals shall be reflectorized in accordance with § 191c.6.

(g) *Slip resistance test for pedals.*—The pedal treads shall be thoroughly cleaned with isopropyl alcohol. The tread surface of one pedal shall be placed against the mating pedal with the axis of the pedals at 90° with respect to each other and the plane of the tread surfaces horizontal. The pedals shall be tilted $25° \pm 2°$ in any direction. The pedals shall not slip with respect to each other more than one-sixteenth inch.

(h) *Brake components.*—(1) *Hand-actuated brakes.*—A bicycle shall not be equipped with only a front-wheel brake. When a bicycle is equipped with hand-actuated brakes, the hand lever mechanism shall be securely attached to the handlebars in a position that is readily accessible to the rider when the rider is in a normal riding position and the hands are in a normal steering position. When the lowest seat position is 25 in or less from the ground, the maximum grip dimension (the outside dimension across the brake hand lever and the handlebar grip) shall not exceed 3 in at any point between the cable end of the lever and the lever's midpoint. The grip dimension may increase toward the open end of the lever but shall not exceed 3½-inch grip dimension except for the last one-half inch of the lever. On bicycles with a ground-to-seat dimension greater than 25 in, the grip dimensions may be increased one-half inch over the above dimensions. Hand levers fitted to underturned handlebars, commonly referred to as racing handlebars, shall have the maximum grip dimension apply to the contour of the lever intended for finger engagement. The hand lever assembly shall be free of unfinished edges and sharp points that may be potentially hazardous to the rider. Hand levers shall operate without binding or stickiness.

(2) *Brake cables.*—The brake cable assembly shall comply with the test in paragraph (h) (3) of this section.

(3) *Cable assembly test.*—The cable button is held in a fixture resembling its normal seating and a tensile preload of 100 lb is removed and a plot of load versus elongation is made as the cable is loaded up to 400 lb in increments of 100 lb. The cable shall evidence no failure or permanent stretch when the 400-lb load is reduced to 100 lb. The rigidity of the cable shall be at least 35,000 lb/in of elongation per inch of test length. $R=P/e$ where R=rigidity, P=load in pounds, and e=elongation in inches per inch of sample length.

(4) *Brake sheaths.*—When a bicycle is equipped with side-pull brakes, or any other braking system where the sheath over the brake cable is a working part of the brake force system, and the sheath is a coiled wire construction, the coil shall be close wound with positive pretension to insure rigidity in compression.

(5) *Brake sheath test.*—Using a tensile test instrument, measure the tensile force necessary to cause longitudinal deflection of the sheath coils. The force shall be at least 16 ounces.

(6) *Caliper brake assembly.*—When a bicycle is equipped with brakes, the caliper brake assembly shall be attached to the frame of the bicycle securely with nonbrittle fasteners complying with § 191c.5(c). The attaching hardware shall be provided with a locking device consisting of a washer, locknut, or other similar locking device. The caliper mechanism shall operate without binding. The cable anchor bolt shall not cut any of the cable strands. The brake pad shall be capable of being adjusted to engage the wheel braking surface squarely without overhang beyond the surface provided.

(7) *Caliper brakeshoes.*—Caliper brakeshoes shall be replaceable and securely attached to the caliper assembly. The brakeshoe material shall be positively retained in its holder by means of a retainer at each end of the shoe. The brakeshoe material shall withstand a temperature of 250° F. (121° C.) for 30 minutes without any melting or blistering.

(8) *Footbrake assembly.*—When a bicycle is equipped with postbrakes, the footbrake assembly shall be actuated by the operator's foot applying force to the pedal in a direction opposite to that of the drive force. The brake mechanism shall function independently of any drive-gear positions or adjustments. The differential between the drive and brake positions of the crank shall be 45° or less.

(i) *Handlebars.*—(1) Handlebars shall be configured to allow comfortable and safe control of the bicycle. A line between the center points of the handgrips or the normal hand positions shall not pass more than 1 inch to the rear of the turning axis of the head tube. The ends of the handlebars shall be not less than 14 in nor more than 28 in apart. The handgrips shall be symmetrically located with respect to the longitudinal axis of the bicycle and shall be not more than 16 in above the seat surface when the seat is in its lowest position and the handlebars are in their highest position. The ends of the handlebars shall be fitted with handgrips or end plugs that are secured against a removal force of not less than 15 lbs.

(2) The assembled handlebars shall support a force not less than 100 lb with a deflection of zero to 2 in when the force is applied evenly divided between the handgrip positions in a direction to cause a maximum torque against the handlebar clamp and the deflection is measured along the line of applied force. The handlebars shall also resist without movement a torque of 35 ft-lb against the fork-stem clamp.

(j) *Seat.*—No part of the seat, seat supports, or accessories attached to the seat shall be more than 5 in above the top seat surface at the point where the seat surface is intersected by the seat post axis. The seat post shall contain a permanent mark or ring that clearly indicates the minimum insertion or maximum seat height adjustment. This mark is to be located at a point not less than two diameters of the seat post measured from the lowest point on the post shaft. The mark shall not detract from the structural integrity of the seat post. The seat adjustment clamps shall resist without movement a torque of 25 ft-lb applied in a horizontal plane and a torque of 75 ft-lb applied in a vertical plane.

(k) *Drive chain.*—The drive chain shall operate over each bicycle sprocket without binding. The tensile strength per shall operate over each bicycle sprocket not less than 1,800 pounds.

§ 191c.5 Mechanical integrity.

(a) *Construction.*—There shall be no brittle fracture of a frame component or of a steering, wheel, pedal, crank, or brake system component as a result of the tests specified in this part 191c.

(b) *Adjustments.*—There shall be no visible or measurable deterioration of adjustments or attachments of load carrying, steering control, or braking control components during the inspection and testing of the bicycle in accordance with this part 191c.

(c) *Attaching hardware.*—Any screws, bolts, or studs used to attach or secure components shall be nonbrittle. Such hardware, capable of being clamped in a vise by one-half its length, shall be bent through an angle of 20° from its original position without fracture. All threaded hardware shall be of sufficient quality to allow adjustments and maintenance. Acceptable quality thread form is specified in "Handbook H28—Screw-Thread Standards for Federal Services," issued by the National Bureau of Standards, Department of Commerce.[1]

§ 191c.6 Reflectorization.

A bicycle shall be equipped with reflective devices to provide a minimum level of recognition and identification under illumination from the active head lamps

[1] Copies may be obtained from: Superintendent of Documents, U.S. Government Printing Office, Washington, D.C. 20402.

of a motor vehicle. The quality of the reflective elements is specified in paragraph (e) of this section.

(a) *Front reflector.*—There shall be a front-facing, colorless reflector mounted on the bicycle. The mounting device and reflector shall be protected against misalinement when a force of 20 pounds is applied to the reflector or the mounting device in any direction. The test force shall be applied to the reflector and/or mount by a loop of ordinary ¼-inch clothesline rope. The reflector or mount shall not contact the ground plane when the bicycle is resting on that plane in any orientation. The horizontal-vertical optical axis of the reflector shall be within 5° of the horizontal-vertical alinement of the bicycle when the bicycle wheels are tracking a straight line. The reflectors and/or mounts shall incorporate a provision to preclude assembly of the reflector to the mount in other than the intended horizontal-vertical alinement.

(b) *Rear reflector.*—There shall be a red color, rear-facing reflector mounted on the bicycle and optically alined, horizontally and vertically, within 5° of the alinement of the bicycle when the bicycle wheels are tracking in a straight line. The mounted reflector shall not be obscured by a rider or his appropriate clothing. A mackinaw or Navy pea jacket with slacks or skirt is considered appropriate clothing. The mounting and protection shall be as specified in paragraph (a) of this section.

(c) *Pedal reflectors.*—Each pedal shall be equipped with reflectors complying with paragraph (e) of this section. Each pedal shall have a reflector located on both the front and rear surfaces of the pedal. The pedal reflectors shall be colorless or amber in color. The reflectors shall be sufficiently recessed from the edge of the pedal or of the reflector housing to prevent contact of the lens with a flat surface placed in contact with the edge of the pedal. The reflector elements may be integral with the construction of the pedal or mechanically attached. The reflector shall be tested for optical compliance as a part of the pedal assembly. The reflector shall be tested for conformance with paragraph (e) (1) and (3) of this section as a detachable component or as an integral part of the pedal, depending upon the method of attachment to the pedal.

(d) *Side reflectors.*—A reflective device shall be affixed to each side of each tire or mounted on the wheel spokes within 3 inches of the outside diameter of the wheel rim. The reflective device shall be so mounted that a plane perpendicular to the zero optical axis is parallel to a plane that is between the planes tangent to the conical spoke cage on either side of the wheel. The side-mounted reflective device shall not interfere with any wheel adjustment or cause or aggravate wheel imbalance due to nonuniformity of tire. The side-mounted reflector devices shall reflect red or white light on the rear wheel and amber or white on the front wheel.

(e) *Prismatic reflector performance.*—All prismatic reflex reflectors shall meet the photometric requirements of table I and the wide-angle requirements of table II. All photometric measurements shall be determined in accordance with the testing procedure as detailed in SAE Standard J594e, "Reflex Reflectors," 1973 SAE Handbook, pages 768–69.[3] Where values for observation angles of 0.2° and 0.3° are given, the reflector shall meet either the 0.2° or 0.3° requirements and the 1.5° requirement. The following conditioning shall be performed (in the order shown) before these photometric tests are conducted.

(1) *Warpage test.*—The reflector shall be held in an oven for 1 hour at 120° F. A pedal reflector may be tested as integral with its pedal.

(2) *Mechanical impact.*—The reflector shall be mounted, face up, in a manner similar to the way in which it is mounted on the bicycle, or the reflector may be tested as mounted. A ½-inch-diameter polished steel ball shall be dropped normal to the center of the face of the reflector from a height of 30 inches. The ball may be guided by a tube with holes but not restricted in free fall. Pedal reflectors are exempt from this impact test.

(3) *Moisture seal test.*—The reflector shall be submerged in tap water in a suitable container. The container shall be pressurized to 2.5 lb/in² (pounds per square inch) (equivalent to 5.625 feet of water) for 15 minutes and then released.

(f) *Retroreflective tire sidewalls.*—(1) *Characteristics.*—When reflective tire sidewalls are used for side reflectorization, the reflecting material shall have the following characteristics:

(i) *Spatial distribution of the reflecting material.*—The reflecting material shall extend completely around the circumference of the sidewall. The reflecting strip to be considered shall be bounded by two concentric circles, the larger of which is no more than 0.02 (0.79 inches) meters greater in radius than the smaller. While additional reflecting material is permitted outside such boundaries, it shall not be considered as part of the reflector in meeting the requirements of this specification. Such additional material shall not be counted in calculating the average width of the reflecting strip and shall be masked off with opaque, matte black tape in the range tests of the reflecting material.

(ii) *Orientation of the reflecting material.*—With the tire properly mounted and inflated, every portion of the reflecting strip shall be oriented so that the normal to its surface is within 25° of parallel to the axis of rotation of the wheel. While additional reflecting material with other orientations is permitted, it shall not be considered as part of the reflector in meeting the requirements of this specification. Such additional material shall not be counted in calculating the average width of the reflecting strip and must be marked off with opaque, matte black tape in the range tests of the reflecting material.

[3] Copies may be obtained from: Society of Automotive Engineers, Inc., 2 Pennsylvania Plaza, New York, N.Y. 10001.

(iii) *Reflectance properties.*—The mathematical description of the reflectance properties as given in this subdivision shall serve as the definition of the performance required of the sidewall reflector. The measurement procedures described elsewhere in this part 191c related to this specification shall be regarded as specifying practical means for evaluating the performance of the reflecting strip under this definition. In case of doubt, it shall be demonstrated that the material satisfies this definition, results of other tests notwithstanding. The average reflectance factor ρ (relative to a perfect white diffusing reflector) of the tire sidewall taken over the 0.02 meter (0.79 inches) strip radially shall be at least that given by the expression:

$$\bar{\rho}=\frac{100}{1+\left(\frac{\phi}{0.225}\right)^{3/2}}$$

where ϕ is the angle between the direction of incidence and the direction of viewing at any point on the sidewall. The formula above shall apply for angles of incidence up to 40° and angles of divergence ϕ up to 1.5°. The reflectance is not specified beyond these limiting angles.

(iv) *Color.*—The sidewall reflecting strip shall be as colorless as possible; that is, the spectral reflectance shall be nearly constant over the visual range. In case of doubt, by visual examination the appearance of the sidewall by retroreflection as compared to painted chips under the same illuminant shall, for the same hue, appear to have less chroma than Munsell chroma/2 Munsell Book of Color.[4]

(2) *Specific test for reflectance factor.*—This test is based on Federal Specification L–S–300A, "Sheeting and Tape, Reflective Nonexposed Lens Adhesive Backing," Federal Supply Service, General Services Administration.[4]

(i) *Apparatus.*—Arrangement for the reflective intensity test shall be as shown in figure 3. The light projector, having a maximum lens diameter of 1 in and capable of projecting a uniform light, shall be used to illuminate the sample. The light falling on the sample shall have a color temperature of 2856 K (equivalent to source A, figure 1–3, "Relative Energy Distribution of Sources A, B, and C," IES Lighting Handbook, fifth edition (1972).[5] The light reflected from the test surface shall be measured with a photoelectric receiver the response of which has been corrected for the spectral sensitivity of the average photopic human eye. The dimensions of the active area of the receiver shall be such that no point on the perimeter is more than one-half inch from the center. Tires to be tested shall be mounted on a wheel,

[4] Copies may be obtained from Munsell Color Co., 2441 North Calvert Street, Baltimore, Md. 21218.

[4] Copies may be obtained from Specifications Sales, Building 197, Washington Navy Yard, GSA, Washington, D.C. 20407.

[5] Copies may be obtained from Illuminating Engineering Society, 345 East 47th Street, New York, N.Y. 10017.

the rim and spokes of which have been masked in flat black so that when measured without the tire they indicate no appreciable reflectance. The tire shall be properly mounted and fully inflated. Distances shall be measured from the point of intersection of the axle of the wheel with the center of the wheel. For the tests, the wheel shall be 15 m (49.2 ft) plus or minus 0.1 m (3.9 in) from the projecting lens.

(ii) *Test procedure.*—Measure the distance from the receiver to the specimen, the average diameter of the radial bounding circles as defined in paragraph (f)(1)(i) of this section, and mask off nonapplicable portions of the reflecting material as indicated in paragraph (f)(1)(i) and (ii) of this section. Measure the illumination incident on the wheel at the radius of the reflecting strip and at uniform intervals of more than 45° around the wheel, with the receiver oriented in the direction of the incident radiation. The average of such readings will be the mean illumination of the sample, E_s. If any one of such readings differs by more than 10 percent from the mean illumination, then a more uniform source must be obtained. Measure the illumination of the receiver due to reflection from the sidewall for each angle of incidence and each angle of divergence given in table III. The illumination incident on the test surface and the receiver shall be measured in the same units. Compute the average reflectance factor from the following equation:

$$\bar{\rho}=\frac{25}{\cos^2\theta}\times\frac{E_r}{E_s}\times\frac{d^2}{r}$$

where

E_r=Illumination incident upon the receiver.
E_s=Illumination incident upon a plane perpendicular to the incidence ray at the specimen position (see instructions above for averaging), measured in the same units as E_r.
θ=The angle between the direction from the center of the wheel to the light source and the axle of the wheel.
d=The distance from the receiver to the center of the wheel in meters.
r=The average radius of the boundary circles of the retroreflective strip, as defined in paragraph (f)(1)(i) of this section, in meters.

The reflectance factor shall comply with requirements of table III.

(3) *Mechanical integrity of reflective sidewalls.*—(i) Abrasion of the inflated tire wall with a wet, steel bristle brush shall show less damage than the adjacent sidewall not covered with the reflective material.

(ii) The reflective material shall be applied as part of the tire manufacturing process and shall withstand 250° F. for 30 minutes with no evidence of the reflective material separating from the base-tire material.

(iii) The reflective material shall not contact the ground plane when the assembled bicycle is resting on that plane.

A bicycle shall be capable of passing the following road test.

(a) Each bicycle selected for the road test shall be ridden at least 4 miles by an operator weighing between 150 and 185 pounds with the tires inflated to maximum recommended pressure. Travel shall include riding the bicycle five times over a 100-foot course of wooden cleats. The cleats shall be nominally 1-inch high by 2-inch wide finished lumber with ½ by 45° chamfer on the corners contacting the tires. The cleats shall be spaced every 6 feet over the 100-foot course.

(b) During the road test the bicycle shall exhibit stable handling in turning and steering without difficulty of operation. There shall be no structural or component failure of the brake system, no tire failures, no structural fractures, and no loosening or misalinement of the reflectors. Any misalinement of seat or handlebars shall be restorable to normal alinement by adjustment provided; any realinement shall be subject to integrity tests as specified in § 191c.4 (i) and (j).

§ 191c.8 Brake performance.

A bicycle shall be equipped with a braking system capable of meeting the performance requirements of this section.

(a) *Group designation.*—Each bicycle tested shall, for test purposes, be assigned a group designation according to the maximum ground speed of the unit in its highest gear ratio and at a pedal crank input of 60 revolutions per minute.

(1) *Group A.*—Units with ground speed of 15 mi/h or greater shall stop within a distance of 15 feet from a velocity of 15 mi/h on a dry, clean, level paved surface.

(2) *Group B.*—Units with a ground speed of less than 15 mi/h shall stop within a distance of 15 feet from a velocity of 10 mi/h on a dry, clean, level paved surface.

(b) *Test basis.*—A bicycle equipped with a foot-operated brake and a hand-operated brake shall be considered as having two braking systems. The foot-brake system shall be considered as the primary braking system and shall meet group B requirements. If the bicycle falls within group A, the combined systems may be used to meet group A requirements.

(c) *Hand-operated brakes.*—Hand-operated brakes shall meet the requirement of this section with a handgrip force not exceeding 40 pounds. The 40 pounds of force shall be applied to the hand lever at a point not closer than 1 inch to the open end of the lever. The stopping distance requirement is based on a rider weight of 150 pounds; greater stopping distance shall be allowed for heavier riders at the rate of 1 foot per 10 pounds. The weight of the test-rider shall be between 150 and 185 pounds.

(d) *Foot-operated brakes.*—Foot-operated brakes shall enable a bicycle to meet the requirements for group A without allowance for rider weight or pedal force. In addition, the braking force transmitted to the rear wheel as a result of applied pedal force shall meet the requirements of paragraph (e) of this section.

(e) *Brake force for footbrakes.*—Brake force for footbrakes shall be measured tangentially to the circumference of the rear tire when the tire is rotated in the direction of forward movement. The brake force shall be linearly proportional (within 10 percent) to a pedal force of from 20 to 70 pounds but shall be not less than 40 pounds of brake force for 70 pounds of pedal force.

§ 191c.9 Qualifications for sidewalk bicycles.

A sidewalk bicycle shall comply with all provisions of this part 191c except:

(a) The provisions of § 191c.3(j) are not applicable for nonpneumatic tires.

(b) Section 191c.4 applies (where a sidewalk bicycle is equipped with the components described), with the following exceptions and modifications:

(1) Paragraphs (a)(3) through (d) of § 191c.4 are not applicable.

(2) Section 191c.4(e) applies except that a load of 250 pounds shall be substituted for the 450-pound load.

(3) Section 191c.4(f) applies except there shall be no requirement for reflectorization.

(4) In § 191c.4(h), only subparagraph (8) applies.

(5) Section 191c.4(i) is applicable except that the handlebar clamp(s) shall resist a torque of 15 foot-pounds without movement between the clamped parts.

(6) Section 191c.4(j) applies except that the seat adjustment clamp(s) shall resist a torque of 15 foot-pounds without movement between the clamped parts.

(c) Section 191c.6 is not applicable.

(d) The following test shall be substituted for the road test provisions of § 191c.7: A sidewalk bicycle shall be loaded with a 30-pound weight attached to the seat surface and a 10-pound weight attached to each handle grip, for a total of 50 pounds. The bicycle shall be held in an upright position and dropped three times a distance of 1 foot onto a paved surface. As a result of this test the bicycle or its components shall not suffer fracture failure of wheels, frame, seat, handlebars, or fork. In addition, the unloaded sidewalk bicycle shall be allowed to fall from an upright position to the paved surface three times on each side without fracture to the pedals or handgrips.

(e) The following shall be substituted for § 191c.8 regarding brake performance: A sidewalk bicycle with a seat-to-ground dimension of 22 inches or greater, with seat in lowest position according to adjustment provided, shall be equipped with a foot-actuated brake. A bicycle less than the 22-inch dimension and not equipped with a brake shall not have a coasting or freewheeling feature. A bicycle not equipped with a brake shall be so labeled on the chain guard in legend visible from a 10-foot distance in daylight conditions, and the words "NO BRAKE" shall appear on the carton. A sidewalk bicycle shall not have hand-operated brakes as the primary braking system. The brake system shall transmit braking force to the rear wheel in proportion to actuation forces of 10 to 50 pounds in the ratio of 1 pound of wheel braking force for 2 pounds of pedal actuating force. The wheel braking force shall be measured tangentially at the tread of the tire.

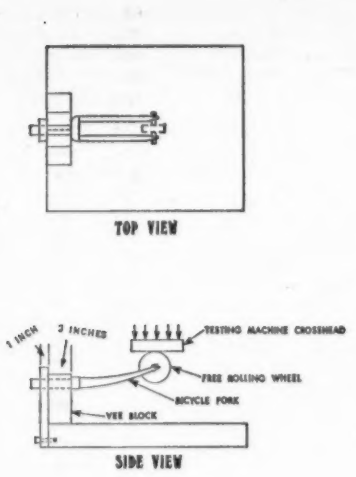

FIGURE 1 - Schematic of test set up for cantilever bending tests of bicycle forks

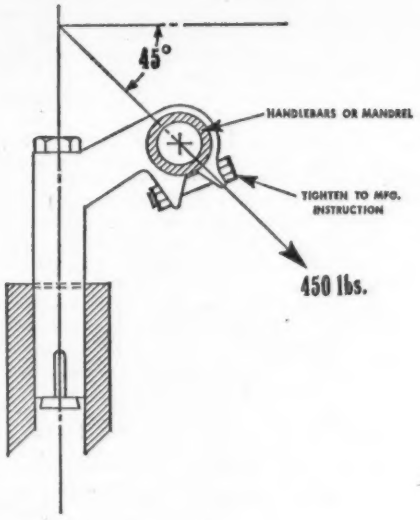

FIGURE 2 - Handlebar Stem Loading

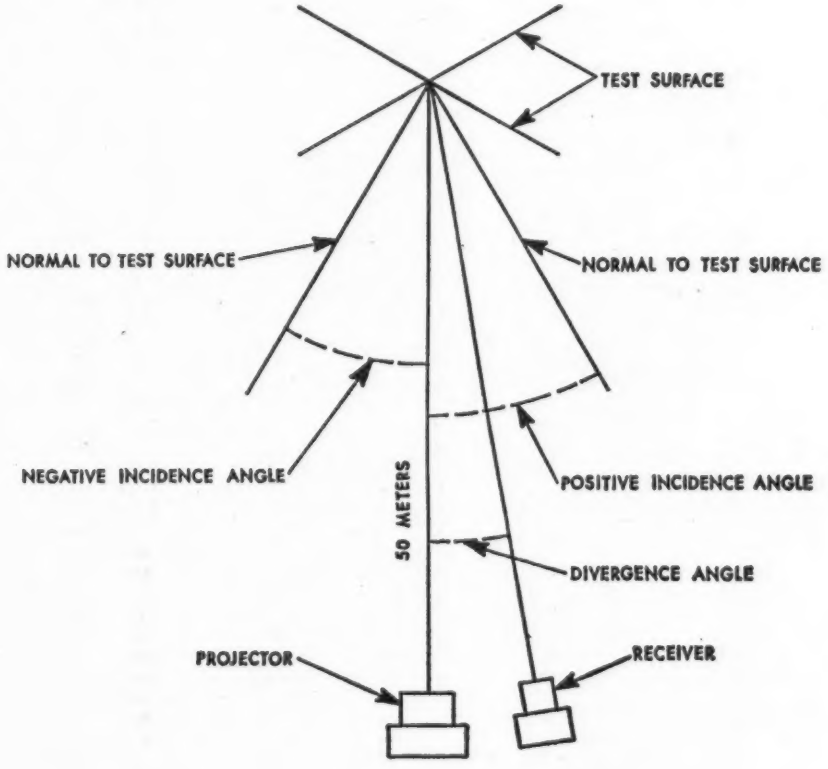

FIGURE 3 - Incidence and Divergence Angles

TABLE I—MINIMUM CANDLEPOWER PER INCIDENT FOOT-CANDLE FOR CLEAR PRISMATIC REFLECTOR[1]

Observation angle	Front, rear, and side reflectors; entrance angle in degrees			Pedal reflectors; entrance angle in degrees		
	0	10 up/down	20 left/right	0	10 up/down	20 left/right
0.2	27.0	18.0	9.0	7.5	6.0	3.0
0.3				6.0	4.8	2.4
1.5	.28	.20	.12	.28	.20	.12

[1] Amber values shall be ⅓ × clear values. Red values shall be ¼ × clear values.

TABLE II—MINIMUM CANDLEPOWER PER INCIDENT FOOT-CANDLE FOR CLEAR PRISMATIC REFLECTOR[1]

Observation angle	Front, rear, and side reflectors; entrance angle in degrees		
	30 left/right	40 left/right	50 left/right
0.2	8.0	7.0	6.0
1.5	.12	.12	.12

[1] Amber values shall be ⅓ × clear values. Red values shall be ¼ × clear values.

TABLE III—MINIMUM ACCEPTABLE REFLECTANCE FACTOR RELATIVE TO A PERFECTLY REFLECTING DIFFUSE REFLECTOR FOR REFLECTIVE SIDEWALL TIRES (SPECIFIC INTENSITY/UNIT LENGTH)

Angle of divergence	Angle of incidence	Minimum acceptable reflectance factor
Degrees	*Degrees*	
0.2	−4	60
.2	20	60
.2	40	60
1.5	−4	6
1.5	20	6
1.5	40	6

Interested persons may, on or before July 9, 1973, file with the Hearing Clerk, Department of Health, Education, and Welfare, room 6–88, 5600 Fishers Lane, Rockville, Md. 20852, written comments (preferably in quintuplicate) regarding this proposal. Comments may be accompanied by a memorandum or brief in support thereof. Received comments may be seen in the above office during working hours, Monday through Friday.

Dated May 4, 1973.

SAM D. FINE,
Associate Commissioner for Compliance.

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